

SOME STATISTICS OF GARBAGE DISPOSAL FOR THE LARGER AMERICAN CITIES IN 1902.

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In connection with the work of the course in municipal sanitation at the Massachusetts Institute of Technology, the writers attempted to collect a certain amount of first-hand information as to the condition of garbage disposal practice in the United States in the year 1902. Blanks were sent out to cities of over 25,000 population (161 in number), and after several attempts replies were finally received from 155 of them. Results obtained, in this manner, by circular are of course subject to many errors. Our inquiry was more limited in its scope than that undertaken by the committee of the American Public Health Association on the "Disposal of Garbage and Refuse" presented by Mr. Rudolph Hering in 1897¹, and we hope to add little to the masterly treatment of the whole subject of garbage disposal in Dr. C. V. Chapin's "Municipal Sanitation"². Nevertheless, in the belief that our data may furnish some fresh material for students of this important problem, we have thought it worth while to publish the tabulated results.

The most general conditions of the garbage problem in the larger American cities in 1902 is indicated in Table I where are given the answers to the question whether garbage is regularly collected and by whom, whether waste materials are separated into classes before treatment and what treatment is accorded to each class.

TABLE I.
GARBAGE DISPOSAL IN THE LARGER AMERICAN CITIES.

Number.	City.	Population 1900.	Garbage regularly collected.	By whom collected.
1	Akron, Ohio.....	42,728	Yes	Private parties
2	Albany, N. Y.*.....	94,151	No .....	.....
3	Allegheny, Pa.....	129,896	Yes	Contractor
4	Allentown, Pa.*.....	35,416	Yes	Contractor
5	Altoona, Pa.....	38,973	No .....	.....
6	Atlanta, Ga.....	89,872	Yes	City
7	Atlantic City, N. J.....	27,838	Yes	Contractors and private parties...
8	Auburn, N. Y.....	30,345	Yes	Contractors
9	Augusta, Ga.....	39,441	Yes	City
10	Baltimore, Md.*.....	508,957	Yes	City
11	Bay City, Mich.....	27,628	Yes	Contractors
12	Bayonne, N. J.....	32,722	Yes	City
13	Binghampton, N. Y.....	39,647	No	Private parties
14	Birmingham, Ala.....	38,415	Yes	Contractor
15	Boston, Mass.....	560,892	Yes	City and contractor.....
16	Bridgeport, Conn.....	70,996	Yes	Contractor
17	Brockton, Mass.....	40,063	Yes	City
18	Buffalo, N. Y.....	352,387	Yes	City
19	Butte, Mont.*.....	30,470	.....	.....
20	Cambridge, Mass.....	91,886	Yes	City
21	Camden, N. J.....	75,935	No	City
22	Canton, Ohio*.....	30,667	No	Private parties
23	Cedar Rapids, Iowa.....	25,656	Yes	Contractor
24	Charleston, S. C.....	55,807	Yes	City
25	Chattanooga, Tenn.....	30,154	Yes	City
26	Chelsea, Mass.....	34,072	Yes	Private parties
27	Chester, Pa.....	33,988	.....	.....
28	Chicago, Ill.....	1,698,575	Yes	City
29	Cincinnati, Ohio.....	325,902	Yes	City
30	Cleveland, Ohio.....	381,768	Yes	Contractors

TABLE I.
GARBAGE DISPOSAL IN THE LARGER AMERICAN CITIES.

Separation of material.	Disposal of ashes.	Disposal of combustible wastes.	Disposal of garbage.	Number.
All separated	Not given	Not given	Not given	1
.....	.....	.....	Dumped and fed to swine..	2
Only G. collected....	Dumped	Burned on dump....	Used for fertilizer.....	3
G. separated	Dumped	Dumped	Part buried, part used for fertilizer	4
.....	Dumped	Dumped	Burned in cook stoves.....	5
All separated .....	.....	Cremated	Cremated	6
G. separated	Not collected.....	Not collected	Cremated	7
All separated	Dumped	Dumped	Buried four feet deep.....	8
Not separated	Burned on dump....	Burned on dump....	Burned on dump.....	9
G. separated	Dumped	Dumped	Used as fertilizer, fed to swine	10
G. separated, A. and C. W. sometimes...	Used upon public streets	Burned	Used as fertilizer, and fed to swine	11
Not separated	Dumped	Dumped	Dumped	12
Not separated	Dumped	Not known	Buried or burned in cook stoves	13
Not separated	Dumped	Dumped	Dumped	14
All separated	Dumped, taken to sea	Dumped, utilized...	Reduced	15
G. separated	Dumped	Burned	Cremated	16
All separated	Dumped	Burned	Fed to swine	17
G. separated	Dumped	Dumped	Reduced	18
.....	.....	.....	Cremated	19
All separated	Dumped	Burned	Fed to swine	20
All separated	Dumped	Cremated	Cremated	21
.....	.....	.....	Cremated	22
G. separated .....	.....	Burned	Dumped and fed to swine....	23
Not separated	Dumped	Dumped	Dumped	28
Not separated	Dumped and partly burned	Dumped and partly burned	Dumped and partly burned..	25
G. separated	Dumped	Burned	Fed to swine.....	26
.....	.....	.....	.....	26
Not separated	Dumped	Dumped	Dumped	24
All separated	Dumped	Dumped	Reduced	29
G. separated	Dumped	Dumped	Reduced	30

TABLE I — Continued.

Number.	City.	Population 1900.	Garbage regularly collected.	By whom collected.
31	Columbus, Ohio.....	125,560	Yes	Contractors
32	Council Bluffs, Iowa.....	25,802	No	Private parties
33	Covington, Ky.....	42,938	Yes	City
34	Dallas, Texas.....	42,638	Yes	City and private parties.....
35	Davenport, Iowa.....	35,254	Yes	City
36	Dayton, Ohio.....	85,333	Yes	City
37	Denver, Colo.....	133,859	Yes	Contractors
38	Des Moines, Iowa*.....	62,139	.....	.....
39	Detroit, Mich.....	285,704	Yes	Contractor
40	Dubuque, Iowa.....	36,297	Yes	Contractor
41	Duluth, Minn.....	52,969	No	Private parties
42	Easton, Pa.....	25,238	No	Private parties
43	East St. Louis, Ill.....	29,655	No .....	.....
44	Elizabeth, N. J.....	52,130	Yes	Contractor
45	Elmira, N. Y.....	35,672	No .....	.....
46	Erie, Pa.....	52,733	Yes	Contractor
47	Evansville, Ind.....	59,007	Yes	City
48	Fall River, Mass.....	104,863	Yes	Contractor
49	Fitchburg, Mass.....	31,531	Yes	Contractors
50	Fort Wayne, Ind.....	45,115	Yes	City
51	Fort Worth, Texas.....	26,688	No	Private parties
52	Galveston, Texas.....	37,789	Yes	City
53	Gloucester, Mass.....	26,121	Yes	Private parties
54	Grand Rapids, Mich.....	87,565	Yes	Private parties
55	Harrisburg, Pa.....	50,167	Yes	Private parties
56	Hartford, Conn.....	79,850	Yes	Contractor
57	Haverhill, Mass.....	37,175	Yes	Contractor
58	Hoboken, N. J.....	59,364	Yes	Contractor
59	Holyoke, Mass.....	45,712	Yes	Contractor
60	Honolulu, H. I.....	39,306	Yes	City
61	Houston, Tex.*.....	44,633	Yes	City
62	Indianapolis, Ind.....	169,164	Yes	Contractor
63	Jackson, Mich.....	25,180	Yes	Private parties
64	Jacksonville, Fla.....	28,429	Yes	City

TABLE I—Continued.

Separation of material.	Disposal of ashes.	Disposal of combustible wastes.	Disposal of garbage.	Number.
G. separated	Dumped	Dumped	Reduced	31
Not separated	Dumped	Dumped	Covered on dump	32
All separated	Dumped	Burned on dump...	Burned on dump.....	33
G. separated	Dumped	Dumped	Cremated	34
G. only collected.....	Dumped .....	.....	Dumped in river.....	35
All separated	Dumped	Dumped	Buried and thrown into river.	36
All separated	Dumped	Dumped	Fed to swine	37
.....	.....	.....	Cremated	38
All separated	Dumped	Dumped	Reduced	39
G. separated	Dumped	Dumped	Dumped in river.....	40
.....	.....	.....	.....	41
All separated	Dumped .....	.....	Dumped in river	42
.....	.....	.....	.....	43
Not separated	Dumped	Dumped	Dumped	44
Not separated	Dumped	Dumped	Dumped	45
G. only collected.....	Dumped	Dumped	Given to farmers and reduced.	46
G. separated	Dumped	Burned	Cremated	47
G. separated	Dumped	Dumped	Fed to swine	48
All separated	Dumped	Burned	Fed to swine	49
All separated	Dumped	Cremated	Cremated	50
Not separated	Dumped	Dumped	Dumped	51
All separated	Dumped	Burned	Burned and dumped.....	52
G. separated	Dumped	Dumped	Fed to swine.....	53
G. separated	Dumped	Burned	Cremated	54
Not separated	Dumped	Dumped	Dumped	55
G. separated	Dumped	Dumped	Buried	56
G. separated	Dumped	Dumped	Fed to swine	57
Not separated	Dumped	Dumped	Dumped	58
G. separated	Dumped	Dumped	Used for fertilizer, fed to swine	59
Not separated	Dumped or taken to sea	Burned	Burned or taken to sea.....	60
Not separated	Dumped	Dumped	Dumped	61
All separated	Dumped .....	.....	Used for fertilizer.....	62
Not separated	Dumped .....	.....	Given to farmers.....	63
Not separated	Dumped	Cremated	Cremated	64

TABLE I—Continued.

Number.	City.	Population 1900.	Garbage regularly collected.	By whom collected.
65	Jersey City, N. J.....	206,433	Yes	City
66	Johnstown, Pa.....	35,936	Yes	Private company
67	Joliet, Ill.....	29,353	Yes	City
68	Joplin, Mo.....	26,023	Yes	Contractor
69	Kansas City, Kans.....	51,418	.....	.....
70	Kansas City, Mo.....	163,752	Yes	City
71	Knoxville, Tenn.....	32,637	Yes	City
72	La Crosse, Wis	28,895	Yes	City
73	Lancaster, Pa.....	41,459	Yes	Contractor
74	Lawrence, Mass.....	62,559	Yes	City
75	Lexington, Ky.....	26,369	No	Private parties
76	Lincoln, Neb.....	40,169	No	Private parties
77	Little Rock, Ark.....	38,307	.....	.....
78	Los Angeles, Cal.....	102,479	Yes	Contractor
79	Louisville, Ky.*.....	204,731	Yes	Contractors
80	Lowell, Mass.*.....	94,969	Yes	City and private parties.....
81	Lynn, Mass.....	68,513	Yes	City
82	McKeesport, Pa.....	34,227	Yes	Private parties
83	Malden, Mass.....	33,664	Yes	City
84	Manchester, N. H.....	56,987	Yes	City
85	Memphis, Tenn.....	102,320	Yes	City
86	Milwaukee, Wis.....	285,315	Yes	City
87	Minneapolis, Minn.....	202,718	Yes	City
88	Mobile, Ala.....	38,469	Yes	City
89	Montgomery, Ala.....	30,346	Yes	City
90	Nashville, Tenn.....	80,865	Yes	City
91	Newark, N. J.....	246,070	Yes	Contractor
92	New Bedford, Mass.....	62,442	Yes	Contractor
93	New Britain, Conn.....	25,998	Yes	Contractor
94	Newcastle, Pa.*.....	28,339	Yes	Private parties
95	New Haven, Conn.....	108,027	Yes	Contractor
96	New Orleans, La.....	287,104	Yes	City
97	Newport, Ky.....	28,301	Yes	City

TABLE I — Continued.

Separation of material.	Disposal of ashes.	Disposal of combustible wastes.	Disposal of garbage.	Number.
Not separated	Dumped	Dumped	Dumped	65
Not separated	Dumped	Burned	Dumped	66
All separated	Dumped	Cremated	Cremated	67
All separated, A not collected	Unknown	Burned	Burned or fed to swine.....	68
.....	.....	.....	.....	69
G. only collected.....	.....	.....	Dumped in river	70
Not separated	Dumped	Dumped	Dumped	71
G. separated	Dumped	Dumped	Dumped in river.....	72
All separated	Dumped	Cremated	Cremated	73
G. separated	Dumped	Dumped	Fed to swine.....	74
.....	.....	.....	.....	75
Not separated	Dumped	Burned	Dumped	76
.....	.....	.....	.....	77
All separated	Dumped	Not collected	Cremated	78
G. separated	Dumped	Dumped	Dumped	79
All separated	Dumped	Dumped	Fed to swine	80
All separated	Dumped	Dumped	Fed to swine, taken to sea....	81
A. separated	Dumped	Cremated	Cremated	82
G. separated	Dumped	Dumped	Fed to swine	83
G. separated	Dumped	Dumped	Fed to swine	84
A. separated	Dumped	Cremated	Cremated	85
G. separated	Dumped	Dumped	Cremated	86
All separated	Dumped	Cremated	Cremated and burned on dumps	87
Not separated	Dumped	Dumped	Dumped	88
Not separated	Dumped	Dumped	Dumped	89
G. separated	Dumped	Dumped	Dumped in river	90
Not separated	Dumped	Dumped	Dumped	91
G. separated .....	.....	.....	Reduced	92
G. separated	Dumped	Dumped	Fed to swine, burned.....	93
All separated	Dumped	Burned on dump....	Burned on dump.....	94
G. separated	Dumped	Dumped	Fed to swine	95
All separated	Dumped	Dumped	Dumped in river.....	96
G. separated	Dumped	Dumped	Dumped on land, and into river	97

TABLE I — Continued.

Number.	City.	Population 1900.	Garbage regularly collected.	By whom collected.
98	Newton, Mass.....	33,587	Yes	Contractor
99	New York, N. Y.....	3,437,202	Yes	Contractor in Brooklyn. City in Manhattan
100	Norfolk, Va.....	46,624	Yes	City
101	Oakland, Cal.....	66,960	Yes	Private parties
102	Omaha, Neb.....	102,555	Yes	Contractor
103	Oshkosh, Wis.*.....	28,284	.....	.....
104	Passaic, N. J.....	27,777	Yes	Contractor
105	Paterson, N. J.....	105,171	Yes	Contractor
106	Pawtucket, R. I.....	39,231	Yes	Contractor
107	Peoria, Ill.....	56,100	No	Private parties
108	Philadelphia, Pa.....	1,293,697	Yes	Contractor
109	Pittsburg, Pa.....	321,616	Yes	Contractor
110	Portland, Me.....	50,145	Yes	Private parties and city.....
111	Portland, Oregon.....	90,426	No	Private parties
112	Providence, R. I.....	175,597	Yes	Contractors
113	Pueblo, Colo.*.....	28,157	No .....	.....
114	Quincy Ill.....	36,252	Yes	Contractor
115	Racine, Wis.....	29,102	No	Private parties
116	Reading, Pa.*.....	78,961	Yes	Contractor
117	Richmond, Va.....	85,050	Yes	City
118	Rochester, N. Y.....	162,608	Yes	Private parties
119	Rockford, Ill.....	31,051	Yes	Contractor
120	Sacramento, Cal.....	29,282	Yes	Private parties
121	Saginaw, Mich.*.....	42,345	No	Private parties
122	St. Joseph, Mo.....	102,979	Yes	Private parties, city.....
123	St. Louis, Mo.....	575,238	Yes	Contractor
124	St. Paul, Minn.....	163,065	Yes	City
125	Salem, Mass.....	35,956	Yes	City
126	Salt Lake City, Utah*.....	53,531	Yes	City
127	San Antonio, Texas.....	53,321	Yes	City
128	San Francisco, Cal.....	342,782	Yes	Private parties
129	Savannah, Ga.....	54,244	Yes	City
130	Schenectady, N. Y.....	31,682	Yes.....	Private parties

TABLE I — Continued.

Separation of material.	Disposal of ashes.	Disposal of combustible wastes.	Disposal of garbage.	Number.
All separated	Dumped	Burned	Fed to swine	98
All separated	Dumped on land and at sea	Sold and dumped at sea	Reduced	99
All separated	Dumped	Cremated	Cremated	100
Not separated	Dumped	Dumped	Dumped	101
Usually separated ...	Dumped	Dumped	Fed to swine, dumped.....	102
.....	.....	.....	Dumped	103
C. W. separated.....	Dumped	Burned	Dumped	104
G. separated	Dumped	Burned on dump....	Reduced	105
G. separated	Dumped	Dumped	Fed to swine.....	106
Not separated	Dumped	Dumped	Dumped	107
G. separated	Dumped	Dumped	Reduced	108
G. separated .....	.....	.....	Reduced	109
G. separated .....	.....	.....	Fed to swine	110
All separated	Dumped	Cremated	Cremated	111
G. separated	Dumped	Burned on dump....	Fed to swine.....	112
.....	.....	.....	Dumped, fed to swine.....	113
All separated	Dumped .....	.....	Fed to swine.....	114
G. separated .....	.....	.....	.....	115
G. separated	Dumped .....	.....	Buried	116
All separated	Dumped .....	.....	Cremated	117
G. separated	Dumped .....	.....	Used by farmers	118
G. separated	Dumped	Dumped	Fed to swine, dumped.....	119
Not separated	Dumped	Dumped	Fed to swine, dumped.....	120
G. separated	Dumped	Dumped	Fed to swine, buried.....	121
All separated	Dumped on land or in river	Burned on dump....	Dumped in river.....	122
G. separated	Dumped	Dumped	Reduced	123
G. separated	Dumped	Dumped	Fed to swine and used as fertilizer	124
G. separated	Dumped	Dumped	Fed to swine	125
All separated	Dumped	Burned on dump....	Buried	126
Not separated	Burned in pits.....	Burned in pits.....	Buried in pits.....	127
Not separated	Cremated	Cremated	Cremated	128
All separated	Dumped	Burned on dump....	Used as fertilizer.....	129
Not separated	Dumped	Dumped	Dumped	130

TABLE I — Concluded.

Number.	City.	Population 1900.	Garbage regularly collected.	By whom collected.
131	Scranton, Pa.....	102,026	Yes	Private company.....
132	Seattle, Wash.*.....	80,671	Yes	Private parties
133	Sioux City, Iowa.....	33,111	Yes	City
134	Somerville, Mass.....	61,643	Yes	City
135	South Bend, Ind.*.....	35,999	No	Private parties
136	South Omaha, Neb.....	26,001	No	Private parties
137	Spokane, Wash.*.....	86,848	No	Private parties
138	Springfield, Ill.....	34,159	No	Private parties
139	Springfield, Mass.....	62,059	Yes	City
140	Springfield, Ohio.....	38,253	No	Contractor
141	Superior, Wis.....	31,091	No	City and private parties.....
142	Syracuse, N. Y.....	108,374	Yes	City
143	Tacoma, Wash.....	37,714	No	Private parties
144	Taunton, Mass.....	31,036	Yes	City
145	Terre Haute, Ind.....	36,673	Yes	Contractor
146	Toledo, Ohio.....	131,822	Yes	Contractors
147	Topeka, Kans.*.....	33,608	No .....	.....
148	Trenton, N. J.....	73,307	Yes	City
149	Troy, N. Y.*.....	60,651	Yes	City
150	Utica, N. Y.....	56,383	Yes	Contractor
151	Washington, D. C.....	278,718	Yes	Contractor
152	Waterbury, Conn.....	45,859	Yes	Private parties
153	Wheeling, W. Va.....	38,878	Yes	Contractor
154	Wilkesbarre, Pa.....	51,721	Yes	Contractor
155	Williamsport, Pa.....	28,757	Yes	Private parties
156	Wilmington, Del.....	76,508	Yes	Contractor
157	Woonsocket, R. I.....	28,204	No .....	.....
158	Worcester, Mass.....	118,421	Yes	Private parties
159	Yonkers, N. Y.....	47,931	Yes	City
160	York, Pa.....	33,708	Yes	City
161	Youngstown, Ohio.....	44,885	No	Private parties

TABLE I — Concluded.

Separation of material.	Disposal of ashes.	Disposal of combustible wastes.	Disposal of garbage.	Number.
All separated	Dumped	Cremated	Cremated	131
Not separated	Dumped	Dumped	Dumped	132
G. separated	Dumped	Dumped	Dumped	133
All separated	Dumped	Burned on dump....	Fed to swine.....	134
Not separated	Dumped	Dumped	Dumped	135
All separated	Dumped	Dumped in river....	Dumped in river.....	136
Not separated	Dumped in river....	Dumped in river....	Dumped in river.....	137
Not separated	Dumped	Dumped	Dumped	138
G. separated	Dumped	Dumped	Fed to swine	139
G. separated	Dumped .....	.....	Fed to swine, dumped.....	140
All separated	Dumped	Dumped	Dumped	141
G. separated	Dumped	Dumped	Reduced	142
All separated	Dumped	Burned on dump....	Dumped	143
All separated	Dumped	Burned	Fed to swine	144
A. separated	Dumped	Cremated	Cremated	145
G. separated .....	.....	.....	Plowed into ground.....	146
.....	.....	.....	Cremated	147
A. separated	Dumped	Cremated	Cremated	148
Not separated	Dumped	Dumped	Dumped	149
All separated	Dumped	Dumped	Reduced	150
All separated	Dumped	Cremated	Reduced	151
G. separated	Dumped	Dumped	Cremated	152
A. separated .....	.....	Cremated	Cremated	153
All separated	Dumped	Dumped in river....	.....	154
Not separated	Dumped	Dumped	Dumped	155
G. separated	Dumped .....	.....	Cremated	156
.....	Dumped	Dumped	Dumped	157
All separated	Dumped	Dumped	Fed to swine	158
G. separated	Dumped	Dumped	Cremated	159
G. separated	Dumped	Dumped	Taken to phosphate works...	160
All separated	Dumped	Cremated	Cremated	161

It is probable that some cities reporting no regular collection of garbage are really better cared for in this respect than some which state that garbage is regularly collected by private parties, but on the face of the returns, 29 cities out 155 have no systematic method of collection. Of 146 cities reporting on the routine of collection, only 61 state that the removal of garbage is in the hands of municipal officers, while in 85 cases contractors or private parties are said to exercise this function. The proportion of cities collecting their own garbage is thus about the same as that reported by Hering in 1896⁸. The results tabulated by Goodrich³ indicate that the collection of garbage by contract is the cheaper method although that author's personal opinion contradicts his own figures. At any rate, it appears that even in 1902 only some 40 per cent of the communities considered had inaugurated a system of municipal removal. The number of collections of garbage per week varies from one to six, most cities reporting two or three with more frequent visits to hotels and large apartment houses. In the southern cities daily collections are common; and this practice should be more general. Dr. Chapin has well said that "the most urgent improvement in the management of garbage business is daily collection during the hot weather."⁴

Out of 146 municipalities, 111 report a more or less complete separation of waste materials, the garbage in particular being commonly kept distinct from ashes and combustible wastes. In contrast with European practice this tendency is marked.

With regard to ultimate disposal, almost all the cities report that ashes are dumped on land or used for filling while in a few cases they are dumped, in whole or in part, into the nearest body of water. Combustible waste is dumped on land in 74 cities, burned in 26, cremated or utilized in 19 and thrown into water in 6. The use of ashes for the filling of low lands is no doubt in most cases a satisfactory method of disposal and for the smaller cities it is probably most convenient to treat combustible wastes in the same manner or to destroy them by fire. The larger communities might, however, study with advantage the utilization plants for some time in operation in New York and Boston, where the dry refuse other than ashes is sorted over as it passes along a moving platform so that paper, metal and any other objects of value are recovered and only the worthless residue is burnt.⁸

The methods in use for the disposal of garbage vary more widely; and their relative importance is indicated in the following table. Many cities, of course, appear under two headings since the fate of the garbage of different sections is different.

TABLE II.

Method of Disposal.	Number of Cities.
Dumping on land.....	44
Burning in dump.....	9
Dumping in water.....	14
Ploughing in or using as fertilizer.....	18
Feeding to live stock	41
Cremation	27
Reduction or utilization.....	19
Irregular disposal by private parties.....	11

The most primitive methods of disposal are obviously still the most popular even in the larger American cities. Out of 147 cities reporting in regard to this point, only 46 or less than one-third have any scientific method of treatment. The relation of the size of the community to the method of treatment adopted is shown as follows:

TABLE III.

✓ METHOD OF DISPOSAL.

✓ Size of City.	Dumping.	Burning.	In Water.	Ploughing in.	Feeding to Stock.	Cremation.	Reduction.
Over 325,000.....	1	.....	.....	1	1	1	7
200,000-325,000	3	1	1	.....	.....	2	3
125,000-200,000	1	.....	1	2	3	.....	3
100,000-125,000	1	.....	1	1	4	3	2
80,000-100,000	2	.....	2	1	2	4	.....
60,000-80,000	4	.....	1	3	4	4	1
50,000-60,000	7	1	.....	3	3	1	2
40,000-50,000	3	1	.....	1	3	7	.....
35,000-40,000	5	3	4	3	7	2	.....
30,000-35,000	8	1	.....	1	7	.....	1
25,000-30,000	9	2	4	2	7	3	.....
	44	9	14	18	41	27	19

It appears that reduction methods are used only in the largest cities, that cremators are located from the most part in cities of 40,000 to 100,000 population and that disposal on land and feeding to stock obtain mainly in places of less than 50,000 inhabitants.

Roughly, we may say that of the larger American cities somewhat over a third throw their garbage into water or on waste land,

and an equal number dispose of it to farmers for fertilizer or fodder for stock. In defense of the first of these general methods but little can be said and many of the health officers who replied to our inquiries expressed their disapproval of the condition of affairs. "System is unsatisfactory and unsanitary." "System bad and most unsatisfactory. Any change would be an improvement." "In the summer months this office is busy attending to complaints of this kind," (relating to disposal of garbage). "—————, along with other Mississippi River towns is still culpably polluting its waters by both sewage and garbage. I am doing what I can to hasten the day of garbage cremation and an intercepting sewer with terminal disposal in some more sanitary way."

Again as a city grows the expense of this method of disposal becomes burdensome on account of the necessary increasing length of haul. It almost always creates some nuisance and more or less permanently pollutes the soil. Hering records a case "which indicated that garbage can remain in a decomposing condition for hundreds of years, as evidenced by some excavations in the city of Rome."⁷ Dumping in water is almost equally objectionable in many cases and the expense, according to Hering,⁸ is much greater.

The second great method of garbage disposal, sale to farmers for use as fertilizer or feed for live stock is open to less serious objection when the garbage is fresh and the farms are properly regulated. Waste materials are more promptly removed, better cared for during the process of disposal and finally more or less thoroughly decomposed and converted into food material. Dr. Chapin claims with some justice that the nuisance arising from the feeding of garbage to swine is less than that caused by many cremation and reduction plants and that it might be entirely avoided by proper care and supervision.⁴ The economic results of the system as shown by the experience of many New England cities are most promising. We have received reports of the revenue derived from the sale of garbage in certain municipalities in 1900 as follows: Brockton, \$5,000; Lynn, \$3,537; Lowell, \$3,423; Springfield, Mass., \$1,700; Taunton, Malden and Salem, \$900 each. In Worcester, the receipts from a piggery operated by the city were \$11,947. In St. Paul, 50 cents a ton is received for the raw garbage. Dr. Chapin gives similar figures in the paper quoted and cites a number of instances in which the total expense to the city for the collection and disposal of garbage by this method is less than the cost of collection alone.

For all the largest cities and for many smaller ones, these primitive methods will not indefinitely serve; and the last twenty years have seen remarkable progress in the development of disposal plants

since Capt. Reilly, U. S. A., designed the first cremator for the treatment of the refuse from the fort on Governor's Island, New York, in 1885.⁹ American enterprise has given us two general types of disposal, the reduction plant which utilizes the garbage by the extraction of grease and fertilizer stock and the cremator with a single large chamber and a horizontal garbage grate which aims simply at the quick destruction of the waste materials. The latter form of furnace like the utilization plant, is confined to this country since abroad the cellular cremator with sloping grates is universal.

The incinerator of the former type is the commonest form of disposal plant in the United States. Twenty-seven cities reported to us the existence of the cremation system, and Hering, whose investigation covered many of the smaller cities, recorded forty-two.

As regards the pattern of furnace in the larger cities, it appears that the Dixon is in use in nine localities, the Engle in six, the Smith in three, the Davis in two and the Brownlee, Decarie, Lister, McKay, Thackeray and Vivarttas, each in one. In all the cities of which we have record, the cremators are operated by the municipality with the exception of Atlanta, San Francisco and Waterbury.

For a description of these various types of furnace Chapin² or Locke and Taylor¹⁵ may be consulted.

The Dixon furnace was in use in 1902 at Bridgeport, Camden, Fort Wayne, Jackson, Joliet, Memphis, McKeesport, Wilmington and Youngstown. Bridgeport abandoned the cremator in that year since the cost of burning had risen from an original value of 35 cents a ton to 80 cents with increased cost of coal and labor and made a new contract at 50 cents a ton for reduction with the Connecticut Abattoir and Oil Company. Fort Wayne reports an expenditure of \$3,431 for the consumption of 7,000 tons of garbage, Joliet one of \$1,300 for burning 1,920 tons and McKeesport one of \$1,539 for a quantity not measured. At Youngstown, 7,000 wagon loads are burned with 100 tons of coal per annum, one man being employed to care for the furnace at a salary of \$780. A Dixon furnace burned a portion of the garbage of York up to 1900 at a cost of \$0.80 to \$0.90 a ton.

The Engle cremator was installed at Evansville, Grand Rapids, Milwaukee, Norfolk, Portland and Richmond. The Milwaukee furnace cost \$42,000 to consume 37,500 tons of garbage, "without causing complaints," while at Portland, \$4,742 was paid for the treatment of an amount not stated. It will be remembered that this type of incinerator was the one which operated so successfully in disposing of the refuse of the Chicago Exposition in 1903.¹⁰

The M. V. Smith cremator was in use at Atlantic City, Waterbury and Wheeling; at Waterbury, the total cost of collection and dis-

posal was \$16,000. The Davis type of furnace at Trenton cost \$18,000 for the treatment of 10,500 tons of garbage and at Lancaster where this same incinerator is in use \$7,710 is paid for the collection and disposal of 3,675 tons. No nuisance has been caused at either place. A Davis cremator at Havana is said to have given excellent results at a cost of 36.3 cents for fuel and 79.7 cents for labor per ton of garbage.¹¹

The Decarie plant at Minneapolis more nearly resembles the European models, providing for the drying of the garbage on the sloping tubes of a tubular boiler before it is burned.¹² It treated in 1902, 12,400 tons of garbage at a cost of \$6,790 and without sanitary difficulties. The Brownlee furnace at Terre Haute cost \$2,514 to operate and the McKay cremator at Yonkers¹³ \$4,500, the latter treating approximately 6,000 tons of garbage.

The San Francisco incinerator is of special interest, because, except that at Montreal, it is the only representative in America of the type of furnace with numerous small cells fitted with sloping grate bars, which are almost universal in Germany and England and are used not for garbage alone but for unseparated refuse. The San Francisco plant is operated by the Sanitary Reduction Works under a fifty years' franchise which grants the company the exclusive right to burn refuse and to charge not more than 20 cents per cubic yard therefore. Two per cent of the gross receipts of the company are paid over to the city, amounting in 1901, to \$790.93, while the city pays for the treatment of the garbage of schools, jails, hospitals and other public institutions. The plant in use is composed of 32 cells which discharge by a 9-foot flue into a 15-foot chimney, 275 feet high.

Some 200 tons of mixed refuse are treated daily, an equal amount which should be delivered to the company, being, it is said, dumped by private parties on empty lots in violation of the law. The plant has been in operation about six years and there have been a few complaints of the "smoke coming from the chimney in damp weather"; which it is hoped to obviate in the future by turning the gases back over the fire. No market has yet been found for clinker and unburnt material.

The Montreal plant, so well described at the last meeting of this Association¹⁴, is of the same type and under municipal operation, disposes of the mixed refuse of one section of the city at a cost of 93½ cents per ton, (13,659 tons incinerated in 1901 for \$12,778) but Dr. Pelletier believes that if it were worked to its fullest capacity the expense need not be over 39 cents a ton. Certainly the former rate is extremely high considering the character of the material and the fact that, except in the winter months, no fuel is required except that contained in the refuse.

It is difficult to make any comparison of the cost of garbage disposal in different communities. Per capita rates are wholly misleading on account of the varying thoroughness with which waste materials are collected and the failure to treat more than a small fraction of the total amount collected in many cities. On the other hand, the amount of garbage actually handled is often not recorded or is recorded inaccurately. For a few communities we have been able to calculate the cost per ton of disposal by cremation with some approach to accuracy and we have added some of Dr. Chapin's figures², (indicated by a star), that they may be compared.

TABLE IV.

COST OF DISPOSAL OF GARBAGE BY CREMATION IN AMERICAN CITIES.

City.	Type of Furnace.	Cost per Ton.
Lowell*	Engle	\$1.05-2.19
Lancaster	Davis	2.10
Trenton	Davis	1.71
Milwaukee	Engle	1.12
Jacksonville*	Dixon	1.08
Camden*	Dixon	.73-1.00
Atlantic City*	Smith	.99
Muncie*	Smith	.90
York	Dixon	.80- .90
Dayton*	Dixon	.80
Bridgeport	Dixon	.35- .80
Yonkers	McKay	.75
Joliet	Dixon	.67
Portland*	Engle	.60
Richmond*	Engle	.60
Wilmington*	Dixon	.60
Minneapolis	Decarie	.55
Terre Haute*	Brownlee	.50
Fort Wayne	Dixon	.49
Atlanta*	Dixon	.34
Allegheny*	Rider	.25

Ordinarily, then, we may say that the cost of cremating raw garbage by the American method ranges from \$0.50 to \$1.00 per ton, these figures probably in no case including any allowance for interest or sinking fund.

In the largest cities of the United States, the peculiarly American process of garbage reduction, has become almost universal, seven out of eleven cities with populations over 325,000 having plants of this type in 1902, Baltimore being added to the list in 1903. In all cases grease and fertilizer stock are the two saleable products which it is attempted to recover; and the various utilization works may be divided into two general classes, those in which the grease is ex-

tracted by steam alone and those in which naphtha is used for the purpose¹⁵. The Arnold, Chamberlain and Holthaus plants belong to the first class, the Merz and Simonin, to the second. Other differences affect only minor details of operation, the extraction of the grease, and the pressing, drying and grinding of the solid residue or tankage being the fundamental processes which are always similar in principle. Reduction plants must almost of necessity be operated by private companies under contract with the city.

The Arnold companies have secured control of garbage disposal in some of the largest cities and theirs is to-day the process most in evidence. In Boston, New York, Philadelphia and Washington this system has been for some time in operation; Erie and Utica report similar plants, and a letter from Reading states that an "Arnold-Edgerton" plant was to be erected there in the spring of 1903.

The Boston plant, as originally built, contained some special features of interest in the shape of auxiliary apparatus for extracting ammonia and other valuable products from the tankage^{16, 17}. When, however, this part of the works was destroyed by fire in 1899, it was not thought worth while to rebuild it so that one may conclude it did not prove exceptionally profitable. The bonus paid by the city to the reduction company is \$47,400. In 1900, 75,000 tons of garbage were treated (estimate of Deputy Supt., Street Department), making the price 60 cents per ton. In New York the contract price, for the borough of Manhattan, as given by Dr. Soper¹⁸, was \$189,990, prior to 1901 and \$232,000 since that date. Dr. Chapin² gives the amount of garbage collected in Manhattan as 152,000 tons in 1898 and 151,000 in 1899, and Dr. Soper states that the quantity has not increased materially. On this basis the cost of disposal would be about \$1.25 per ton on the old contract and \$1.55 on the new. Craven¹⁹ places the amount for 1898 at 170,000 tons which would make the price in that year \$1.10. The present contract price for Brooklyn is \$47,990 and the amount handled on the basis of recorded figures is probably not much over 100,000 tons. It would be safe to say that the cost to the whole city is now over \$1.50 a ton although the estimate of 1,500 tons per day, furnished to us by the contractor, would make it only sixty-two cents. In Philadelphia and Washington contracts cover both collection and disposal, the former city paying \$398,000 for the removal and treatment of some 200,000 tons of garbage. In Washington²⁰ the company receives \$51,600 a year for collection and disposal, paying a rebate of 50 cents a ton on all garbage in excess of 20,000 tons. In 1900 no such rebate was paid but in 1901 the city received \$4,000. The only other Arnold plant for which we have figures is that at Utica where \$6,500 per annum is paid for the treatment. Complaints

of nuisance from reduction works of this type have been numerous, particularly in New York, Philadelphia and Boston. In the latter city, after much political agitation and strenuous activity on the part of the board of health culminating in legal proceedings, the reduction company has just been compelled to move its plant from its old situation to one of the islands in the harbor. Washington has attempted to forestall similar difficulties by locating its works 30 miles from the city.

The Chamberlain process in operation at Cincinnati, Cleveland, Columbus, Detroit and Indianapolis is said not to differ widely from the Arnold. In 1900, according to our returns, the contract price paid in these cities for collection and disposal was as follows: Cleveland, \$69,400; Columbus, \$15,800; Detroit, \$51,500; Indianapolis, \$45,000. Dr. Chapin gives the cost of disposal alone at \$0.69 per ton for Indianapolis. The Simonin process, long ago abandoned at Providence and New Orleans, was in 1902 given up at Cincinnati as well and a new contract signed with a Chamberlain company. The Simonin contract price was \$26,000 for disposal alone and according to Dr. Stanton²² the financial failure of the process was largely due to the fact that only a small portion of the garbage of the city was delivered to the company. Under the new system \$76,000 is paid for collection and disposal.

The Holthaus plant at Syracuse is of the same general type as the Arnold but has provision for keeping the garbage in tightly closed receptacles during the whole process of treatment. It is perhaps the least offensive of reduction works, but the cost of treatment is high, \$26,000, or \$2.16 per ton according to Dr. Chapin's estimate.

Of the systems using naphtha for the extraction of grease from garbage, the Merz has been most actively developed, having been installed at Buffalo, Paterson, Pittsburg and St. Louis. The Buffalo plant²¹ has been in operation for nearly fifteen years and in 1902 was treating 36,000 tons of garbage for a contract price of \$15,840, according to the Commissioner of Public Works, without complaints of nuisance. In St. Louis, \$65,500 was paid in 1900 for the treatment of some 70,000 tons of garbage. In 1901 a new three-year contract for \$130,000 a year went into force. The assistant Health Commissioner states that the increased price is due to the fact that a three-year contract only was made in the hope of finding meantime some cheaper method of disposal. Pittsburg pays \$93,890 and Paterson, \$30,000, in both cases for collection and removal together.

The exact nature of the utilization plant in the other two cities, New Bedford and York, has not been reported. The former city pays \$15,000 for the collection and disposal of garbage. At York the

Dixon cremator operated in 1900 had not sufficient capacity to dispose of the 3,000-4,000 tons of garbage collected and so a new contract was made with a "phosphate works" at 80 cents per ton.

The cost of disposal, in those instances where it is possible to estimate it, may be summarized as follows:

TABLE V.
COST OF DISPOSAL OF GARBAGE BY REDUCTION.

City.	Type of Furnace.	Cost per Ton.
Syracuse*	Holthaus	\$2.16
St. Louis	Merz	.93-1.86**
New York	Arnold	.62-1.50°
York	_____	.80
Indianapolis*	Chamberlain	.69
Boston	Arnold	.60
Buffalo	Merz	.44

* From Chapin.

** Earlier and later contract.

° According to varying estimates of amount of garbage treated.

On the whole it appears that the bonus paid to a reduction company is never much less than the amount required to operate a city cremator of the American pattern, without allowance for first cost, and, as in the case of Syracuse and St. Louis, may be a great deal more. Economically considered, the two systems are fairly well balanced as far as the municipality is concerned. Several subsidiary considerations, however, militate against the success of the reduction system. The necessity for operation by a private company under contract introduces possibilities of corrupt bargaining absent from the simple maintenance of a public cremator. The danger of breakdowns in complicated machinery menaces the regular operation of the reduction plant and the changes in the market price of the products recovered threatens its economic stability. Finally, the production of offensive odors has so far proved an inseparable concomitant of the utilization process. The necessary storage and handling of the raw garbage, in the stale and decomposing condition in which it reaches the plant, produces an offensive odor of putrefaction; and the steamed or otherwise treated garbage always gives rise to that peculiar, aromatic smell of carbonization known as the "caramel" odor. It is unnecessary to cite examples of the endless trouble these processes have caused to boards of health. We need only quote Colonel Morse to the effect that "it has been found impracticable to conduct the works so that a nuisance would be wholly prevented²³," and Dr. Durgin's pithy comparison of the reduction and cremation systems, "the one is a nuisance and the other not always a nuisance"²⁴.

As the Zurich investigators concluded, "from a sanitary point of view, cremation is the only correct method of disposal"⁸.

Furthermore, it is probable that cremation, as practiced abroad is cheaper than either reduction or cremation as carried out in this country. The main difference lies in the fact that instead of carting away ashes at considerable expense, the English and German authorities utilize these half-burnt materials to aid the combustion of the garbage. Goodrich expresses naive astonishment at our habits. "What folly it is to actually pay for throwing away enormous quantities of the most useful part of the refuse." "It is really difficult to associate our ingenious friends with such wasteful methods."³ For the destruction of mixed refuse, the English use as we have said, a furnace differing from ours in its cellular character, its sloping grate bars for preliminary drying of the material, and in many cases in being provided with forced draught. The principal types of destructors, (the Horsfall, the Fryer, the Beaman and Deas, the Warner), as described by Hering, in Hamburg and Berlin²⁵ and by Maxwell in the English cities²⁶ all show much similarity in their general plan. All have been operated with perfect sanitary success; and all prevent the nuisance caused by the dumping of refuse other than garbage which defaces some of the most beautiful suburbs of American cities. The cost per ton as given by Maxwell varies from sixpence at Bradford to two shillings and tenpence at Battersea and averages one shilling and three halfpence. Garrett²⁷, gives the following figures—Horsfall, at Edinburgh, one shilling and sevenpence, at Oldham, sevenpence, at Bradford, sixpence,—Beaman and Deas, at Leyton and Dewsbury, one shilling and fivepence,—Fryer, at Liverpool, one shilling, at Bournemouth, elevenpence,—Warner, at Torquay, sixpence to ninepence.

It is impossible accurately to compare these figures with those for American plants since the tons of refuse treated in England include ashes and combustible waste and the cost of disposal of these substances is in most of our cities confused with the expense of collection. Nevertheless, it seems probable that on the whole the English system is the cheaper one. When well managed, as at Shoreditch, the dry refuse furnishes not only enough fuel to burn the garbage but an excess, which in this case is the principal source of power for a municipal lighting plant; and in some places the clinker produced finds a market for the making of mortar or for road beds. The experience of the last few years has in our judgment only confirmed the conclusions of the committee on the "Disposal of Garbage and Refuse,"² that separation of waste materials is neither economical nor desirable, that the cremation of mixed refuse appears to be the most generally satis-

factory process and that this cremation may be best accomplished in furnaces of the English type.

In conclusion we wish to express our thanks to Prof. W. T. Sedgwick and Prof. Dwight Porter of the Massachusetts Institute of Technology, for advice and assistance in the execution of this study.

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NOTES TO TABLE I.

Albany.	According to Chapin, (2).
Allentown.	Dixon cremator to be built.
Baltimore.	Reduction plant now in operation.
Butte.	According to Baker, (6).
Canton.	Dixon cremator in process of construction.
Des Moines.	According to Baker, (6).
Houston.	Cremator not in use.
Louisville.	Experimental Dixon furnace in operation.
Lowell.	Cremator abandoned.
New Castle.	Cremator in process of construction.
Oshkosh.	According to Chapin, (2).
Pueblo.	According to Chapin, (2).
Reading.	Arnold-Edgerton plant to be constructed.
Saginaw.	Plan for cremator under consideration.
Salt Lake City.	City cremator being rebuilt after destruction by fire.
Seattle.	Plan for disposal under consideration.
South Bend.	New cremator under consideration.
Spokane.	Agitation for cremator which will probably soon be built.
Topeka.	According to Baker, (6).
Troy.	Dixon furnace abandoned.

SUMMARY OF TABLE I.

Cities in which disposal of garbage is by dumping on land.

Auburn, N. Y.	Dayton, Ohio.
Bayonne, N. J.	Duluth, Minn.
Birmingham, Ala.	Elizabeth, N. J.
Cedar Rapids, Iowa.	Elmira, N. Y.
Charleston, S. C.	Fort Worth, Texas.
Chicago, Ill.	Galveston, Texas.
Council Bluffs, Iowa.	Hartford, Conn.

Harrisburg, Penn.	Peoria, Ill.
Hoboken, N. J.	Reading, Pa.
Houston, Texas.	Rockford, Ill.
Jersey City, N. J.	Sacramento, Calif.
Knoxville, Tenn.	Saginaw, Mich.
Lincoln, Neb.	Salt Lake City, Utah.
Louisville, Ky.	Schenectady, N. Y.
Mobile, Ala.	Seattle, Wash.
Montgomery, Ala.	Sioux City, Iowa.
Newark, N. J.	South Bend, Ind.
New Britain, Conn.	Springfield, Ill.
Newport, Ky.	Superior, Wis.
Oakland, Calif.	Toledo, Ohio.
Omaha, Neb.	Troy, N. Y.
Passaic, N. J.	Williamsport, Pa.

Cities in which garbage is burned on dumps.

Augusta, Ga.	Minneapolis, Minn.
Chattanooga, Tenn.	New Castle, Pa.
Covington, Ky.	San Antonio, Texas.
Honolulu, H. I.	Tacoma, Wash.
Joplin, Mo.	

Cities in which garbage is dumped into water.

Dayton, Ohio.	Lynn, Mass.
Davenport, Iowa.	Nashville, Tenn.
Dubuque, Iowa.	New Orleans, La.
Easton, Pa.	Newport, Ky.
Honolulu, H. I.	St. Joseph, Mo.
Kansas City, Mo.	South Omaha, Neb.
Lacrosse, Wis.	Spokane, Wash.

Cities in which garbage is ploughed in or used as fertilizer.

Allentown, Pa.	Malden, Mass.
Baltimore, Md.	Manchester, N. H.
Bay City, Mich.	New Haven, Conn.
Binghamton, N. Y.	Rochester, N. Y.
Cambridge, Mass.	St. Paul, Minn.
Erie, Pa.	Savannah, Ga.
Holyoke, Mass.	Somerville, Mass.
Jackson, Mich.	Springfield, Mass.
Lynn, Mass.	Springfield, Ohio.

Cities in which garbage is fed to live stock.

Baltimore, Md.	Denver, Colo.
Bay City, Mich.	Erie, Pa.
Brockton, Mass.	Fall River, Mass.
Cambridge, Mass.	Fitchburg, Mass.
Cedar Rapids, Iowa.	Gloucester, Mass.
Chelsea, Mass.	Haverhill, Mass.

Holyoke, Mass.	Providence, R. I.
Jackson, Mich.	Quincy, Ill.
Johnstown, Pa.	Rockford, Ill.
Joplin, Mo.	Sacramento, Calif.
Lawrence, Mass.	Saginaw, Mich.
Lowell, Mass.	St. Paul, Minn.
Lynn, Mass.	Salem, Mass.
Malden, Mass.	Somerville, Mass.
Manchester, N. H.	Spokane, Wash.
New Britain, Conn.	Springfield, Mass.
New Haven, Conn.	Springfield, Ohio.
Newton, Mass.	Superior, Wis.
Omaha, Neb.	Taunton, Mass.
Pawtucket, R. I.	Worcester, Mass.
Portland, Me.	

Cities in which garbage is cremated.

Atlanta, Ga.	Minneapolis, Minn.
Atlantic City, N. J.	Norfolk, Va.
Bridgeport, Conn.	Portland, Ore.
Camden, N. J.	Richmond, Va.
Dallas, Texas.	San Francisco, Calif.
Evansville, Ind.	Scranton, Pa.
Fort Wayne, Ind.	Terre Haute, Ind.
Grand Rapids, Mich.	Trenton, N. J.
Jacksonville, Fla.	Waterbury, Conn.
Joliet, Ill.	Wheeling, W. Va.
Lancaster, Pa.	Wilmington, Del.
Los Angeles, Calif.	Yonkers, N. Y.
Memphis, Tenn.	Youngstown, Ohio.
Milwaukee, Wis.	

Cities in which garbage is reduced.

Allegheny, Pa.	New York, N. Y.
Boston, Mass.	Paterson, N. J.
Buffalo, N. Y.	Philadelphia, Pa.
Cincinnati, Ohio.	Pittsburg, Pa.
Cleveland, Ohio.	St. Louis, Mo.
Columbus, Ohio.	Syracuse, N. Y.
Detroit, Mich.	Utica, N. Y.
Erie, Pa.	Washington, D. C.
Indianapolis, Ind.	York, Pa.
New Bedford, Mass.	

Cities in which garbage disposal is by various primitive methods.

Akron, Ohio.	Pueblo, Colo.
Albany, N. Y.	Racine, Wis.
Altoona, N. Y.	Topeka, Kansas.
Chelsea, Mass.	Wilkesbarre, Pa.
East St. Louis, Ill.	Woonsocket, R. I.
Lexington, Ky.	